PATENT SPECIFICATION (11) 1 358 466

1 358 466

(21) Application No. 54126/72 (22) Filed 22 Nov. 1972
(44) Complete Specification published 3 July 1974
(51) International Classification A61B 17/04
(52) Index at acceptance
A5R 57

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(19)

(54) SURGICAL INSTRUMENT FOR STITCHING TISSUE WITH SUTURE WIRE

(71) We, VSESOJUZNY NAUCHNO-ISSLEDOVATELSKY I ISPYTATELNY INSTITUT MEDITSINSKOI TEKHNIKI, of 3, ulitsa Kasatkina, Moscow, Union of Soviet Socialist Republics (U.S.S.R.), a state enterprise organised and existing under the laws of U.S.S.R. do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to surgical instruments for stitching tissue with suture wire; it can find application in placing additional sutures on interbronchial and tracheobronchial anastomoses, as well as in applying sutures in confined spaces.

One previously proposed surgical instrument for stitching tissue with suture wire comprises a pincers-like body formed by two mutually hinged jaws having a spring therebetween to urge said jaws apart. An end of each jaw carries a die shaped as a curved needle. An inner surface of each jaw and each die has a slot which extends to a staple magazine disposed on either of the jaws. The magazine is shaped as a rectangular box having an open-ended longitudinal passage along which a pushrod may pass. The inner surfaces of the magazine walls, located in the planes of the jaws, are provided with slots spaced at a predetermined interval apart to form staple recesses. Said magazine slots accommodate legs of the staples so that one of the staple legs is found in the slot of one of the magazine walls, while the other leg is in the slots of the opposite wall, the staple stem being located on the side of the hinge interconnecting the jaws. When the jaws of the body are brought together, the slots of one of the magazine walls co-operate with said slots in the jaws. When the jaws are parted, the magazine remains on one of them.

The pushrod is provided with a butt end and is arranged to travel along the instrument jaws. The cross-sectional dimensions of the pushrod are such as to make it free to pass through the open-ended passage in the magazine to drive out only one staple at a time. The pushrod working stroke is limited by means of an eccentric stop.

The magazine is free to move with respect to the pushrod at a pitch which corresponds to the staple spacing in the magazine.

When in a working position, the jaws are fixed in the instrument body by means of projections provided on the pushrod.

When operating with said instrument, the surgeon retracts the pushrod to the extreme position adjacent the hinge joint of the body. This results in the working ends of the jaws being spring-actuated apart. Then the surgeon pricks the margins of the tissue to be sutured, draws together the jaws, and forces the pushrod towards the dies, with the result that cams provided on the pushrod actuate spring-loaded levers which cause the magazine to move through a pitch corresponding to the staple spacing in the magazine. Thereupon, the projections of the pushrod fix the jaws in a working position. As the pushrod keeps moving, its butt end touches the staple stem and moves the staple towards the die.

One of the staple legs slides along the slot of one jaw, while the other leg does so along that of the other jaw. The staple leg ends reach the die curved portion, pierce the tissue and are bent into the shape of a ring. The diameter of this ring is adjustable with the help of the eccentric stop against which the pushrod rests when in the extreme working position.

To remove the instrument from the stitched tissue, the pushrod is retracted to the extreme position adjacent the hinge, with the result that the jaws are drawn apart and the needles are withdrawn from the tissue. To apply the next suture, the procedure is repeated.

This previously proposed instrument, however, suffers from a number of disadvantages. When the necessity arises for the application of an additional suture to a cartilaginous portion of the bronchial or tracheal anastomosis one needle of the instruments is easy to introduce, but in order to insert the other needle it is necessary to evert the broncheal or tracheal ring which is impeded by adjacent sutures, with the result that the suture applied by the instrument proves to be inferior.

The previously proposed instrument cannot be used for the application of a suture in a deep and narrow operative field, since in such a field the jaws cannot be drawn apart and the tissue being sutured fails to be caught by the two needles.

It is an object of the present invention to provide an instrument for stitching tissue with suture wire, the construction of the instrument being such as to enable the application of additional sutures to a cartilaginous portion of the broncheal or tracheal anastomosis and to make it possible to stitch tissue in a deep and narrow operative field.

According to the present invention there is provided a surgical instrument for use in stitching tissue with suture wire, comprising a body carrying a curved needle an inner concave portion of which has a longitudinal groove, and a feed member mounted on the body for feeding suture wire along the groove, a face of the feed member facing the groove being adapted and arranged so as to be co-operable with suture wire leaving the groove, when the instrument is in use, to bend said suture wire to form a closed stitch.

Preferably, a magazine is mounted on the body for storing lengths of suture wire, the magazine comprising a bush having in its circumference axial slots one of which communicates with said groove, said bush being rotatably mounted in a cylindrical housing whose inner surface forms with the slots of the bush passageways for the lengths of suture wire, and there is provided actuating means for rotating the bush through an angle equal to the angle between adjacent slots of the bush. The actuating means may comprise a cammed portion of the housing with which the feed member is engageable to rotate the housing about the bush against the action of a spring, and a ratchet pawl on the housing arranged to engage one of the slots in the bush to ensure rotation of the bush with the housing under the action of the spring upon disengagement of the feed member from the cammed portion of the housing.

Preferably also the face of the feed member facing the groove has a guide groove arranged to co-operate with said bent length of suture wire.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

Fig. 1 is a general, fragmentarily cutaway view of a surgical instrument for stitching tissue with lengths of suture wire;

Fig. 2 is an enlarged-scale sectional view taken along the line II-II in Fig. 1;

Fig. 3 is an enlarged-scale sectional view taken along the line III-III in Fig. 2;

Fig. 4 is an enlarged-scale sectional view taken along the line IV-IV in Fig. 2;

Fig. 5 is a schematic view of the end of the feed member, needle and suture wire shown at the final stage of the suture application procedure;

Fig. 6 is an enlarged-scale view of the end of the feed member, needle and housing.

Now referring to Figs 1 and 2, the present embodiment of a surgical instrument for stitching tissue with lengths of suture wire has a body 1 made as a stem whose operative end carries a curved needle 2 provided with a guide groove 3 which is formed in an inner concave portion of the curved section of the needle 2 and which is adapted for bending a length 4 (Fig. 2) of suture wire during its being ejected along the guide groove 3. The length 4 of suture wire is essentially a straight stem one end 5 of which is pointed while the other end 6 is blunted. The body 1 carries a magazine for the lengths 4 of suture wire, the magazine being slidable on the body and comprising a bush 7 having longitudinal slots 8 (Fig. 3) on its outer surface. The bush 7 is enveloped by a cylindrical housing 9 so as to be free to turn inside said housing 9, the inner surface of the latter forming together with the surfaces of the longitudinal slots 8 on the bush 7, recesses 10 to accommodate the lengths of suture wire. The cylindrical housing 9 has a flange 11 with an annular recess 12 (Fig. 2), wherein is accommodated a ratchet pawl 13 (Fig. 3) rotatable round a pivot 14, and a spring 15 acting upon a tailpiece 16 of the ratchet pawl 13, whereby a tip 17 of the ratchet pawl 13 extends through an aperture 18 in the cylindrical housing 9 to rest against the lateral wall of the slot 8 in the bush 7. A rod 19 is coupled with the body 1 (Fig. 2), said rod carrying a handle 20 with two holes 21 (Fig. 1) for the surgeon's fingers. One end of a spring 23 (Figs. 1, 4) is fixed on the rod 19 (Fig. 2) by a screw 22 to turn the housing 9 into working position. The other end of the spring 23 engages a slot 24 (Fig. 3) in the flange 11 of the cylindrical housing 9. The extent of rotation of the housing 9 under the action of the spring 23 is limited by a pin 25 (Fig. 2) mounted on the housing 9 and adapted to interact with a pin 26 mounted on the rod 19. The latter has a longitudinal two-

step slot 27 (Fig. 4), the width of a first step 28 of the slot 27 being equal to the width of a feed member in the form of a pushrod 29 (Fig. 2) fixed on a hollow rod 30 provided with a ring 31 (Figs 1, 2) for the surgeon's finger.

The rod 30 along with the pushrod 29 is movable along the body 1 towards the needle 2.

The width of a second step 32 (Fig. 4) of the slot 27 is equal to that of a projection 33 (Fig. 2) on the pushrod 29, as well as to the width of the slot 8 in the bush 7 of the magazine and to that of the groove 3 of the needle 2. With the instrument in an operative position, the second step 32 of the slot 27, the groove 3 of the needle 2, and one of the slots 8 of the bush 7 are in alignment. The pitch of rotation of the bush 7 is equal to the spacing of the slots 8 (Fig. 3).

Provided at the operative end of the pushrod 29 (Figs 2, 5) near a flat 34 on the projection 33, said flat 34 being adapted to interact with the butt of the blunted end 6 of the length 4 of suture wire, is a curved guide groove 35 adapted for final bending of the length 4 of suture wire as the length 4 leaves the guide groove 3 of the needle 2.

The cylindrical housing 9 (Fig. 6) has an open-ended slot 36 in its lateral wall, said slot 36 narrowing towards the needle 2. One of the edges 37 of the slot 36 is inclined with respect to the axis of the housing 9 so that said edge 37 is co-operable with the end of the pushrod 29 as the pushrod 29 moves along the slot 8 in the bush 7 (Fig. 3) towards the needle 2. A rotation of the housing 9 with the ratchet pawl 13 with respect to the bush 7 thus occurs. The return of the pushrod 29 (Fig. 6) and its disengagement from the slot 8 is followed by a rotation of the housing 9 with the bush 7, this rotation being effected by the spring 23 (Fig. 3), until the pin 25 (Fig. 2) engages the pin 26. The narrow portion of the slot 36 (Fig. 6) is equal in width to the pushrod 29. The stroke of the pushrod 29 towards the needle 2 is limited by a wedge block 38 (Fig. 1) resting against a bevelled surface 41 of the rod 30, said wedge block being fixed in place on the handle 20 by a screw 39 and movable together with said handle 20 along a slot 40 of the hollow rod 30. A guard 43 is held by a screw 42 on the hollow rod 30.

The operation of the instrument of the present embodiment is as follows.

With the instrument in an initial position, the body 1, and the pushrod 29 with the hollow rod 30 and the ring 31 assume a position wherein all these components are withdrawn as far as possible from the needle 2. In that position, the projection 33 (Fig. 2) of the pushrod 29 is disengaged from the slot 8 of the bush 7, while the pushrod 29 is outside the slot 36 of the cylindrical housing 9.

The slot 8 (Fig. 2) of the bush 7 accommodating the length 4 of suture wire is aligned with the second step 32 of the slot 27. The length 4 of suture wire is prevented from falling out from the slot 8 by the projection of the cylindrical housing 9 formed by the edge 37 (Fig. 6) of the narrowing slot 36. The wedge block 38 (Fig. 1) is set to a position in which it limits the stroke of the pushrod 29 to a required length.

In the case of the application of auxiliary suture to bronchial anasomosis, the needle 2 is introduced into one margin of the tissue 44 (Fig. 5) to be sutured and is brought adjacent the other margin, while in the case of stitching soft tissue both margins 44 are pricked onto the needle 2. Then the surgeon presses down the handle 20 (Fig. 1) and the ring 31 with his fingers to move the pushrod 29 towards the needle 2. The pushrod 29, upon entering the narrowing slot 36 (Fig. 2), presses against the length 4 of suture wire, drives it forward and exerts pressure upon the edge 37 (Fig. 6), thus rotating the cylindrical housing 9. At the same time, the tip 17 (Fig. 17) of the ratchet pawl 13 comes out from the slot 8 of the bush 7 and, after the end of the pushrod 29 (Fig. 6) has left the housing 9, the tip engages the next slot 8 of the bush 7. As the pushrod 29 (Fig. 6) keeps moving, the length 4 of suture wire passes along the groove 3 and is bent as shown in Fig. 5. Having pierced the tissue to be sutured, the leading end of the length 4 of suture wire engages with the guide groove 35 and, as a result of further motion of the pushrod 29, the length 4 becomes completely bent into a ring.

When the handle 20 (Fig. 2) and the ring 31 are drawn apart, the pushrod 29 is retracted from the needle 2, and once the projection 33 of the pushrod 29 has left the slot 8 of the bush 7, the spring 23 (Fig. 3) exerts pressure upon the wall of the slot 24 to turn the cylindrical housing 9. At the same time, the ratchet pawl 13 turns the bush 7.

As a result, the pin 24 (Fig. 2) rests against the pin 26, i.e., the bush 7 is turned through a distance equal to the spacing of the slots 8 in the bush 7.

Then the needle is extracted from the tissue.

Thus, the instrument is ready for applying a next suture.

The design and construction of the instrument of the present embodiment makes it possible to apply auxiliary sutures to interbronchial, tracheobronchial and metatracheal anastomoses established in sphenoid resection of the bronchus without everting the

cartilaginous ring of the bronchus or trachea, while sutures applied beforehand remain intact.

This embodiment of the instrument also enables suturing in deeply located and narrow places of the operative field, and is also applicable in some cases where use is made of the already known instruments, e.g., in applying sutures on soft tissues.

WHAT WE CLAIM IS:—

1. A surgical instrument for use in stitching tissue with suture wire, comprising a body carrying a curved needle an inner concave portion of which has a longitudinal groove, and a feed member mounted on the body for feeding suture wire along the groove, a face of the feed member facing the groove being adapted and arranged so as to be co-operable with suture wire leaving the groove, when the instrument is in use, to bend said suture wire to form a closed stitch.

2. A surgical instrument as claimed in Claim 1, wherein a magazine is mounted on the body for storing lengths of suture wire.

3. A surgical instrument as claimed in Claim 2, wherein the magazine comprises a bush having in its circumference axial slots one of which communicates with said groove, said bush being rotatably mounted in a cylindrical housing whose inner surface forms with the slots of the bush passageways for the lengths of suture wire, and there is provided actuating means for rotating the bush through an angle equal to the angle between adjacent slots of the bush.

4. A surgical instrument as claimed in Claim 3, wherein said actuating means comprises a cammed portion of the housing with which the feed member is engageable to rotate the housing about the bush against the action of a spring, and a ratchet pawl on the housing arranged to engage one of the slots in the bush to ensure rotation of the bush with the housing under the action of the spring upon disengagement of the feed member from the cammed portion of the housing.

5. A surgical instrument as claimed in any preceding claim, wherein the face of the feed member facing the groove has a guide groove arranged to co-operate with said bent length of suture wire.

6. A surgical instrument substantially as hereinbefore described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1974.
Published at the Patent Office, 25 Southampton Buildings, London. WC2A 1AY, from which copies may be obtained.

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3 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

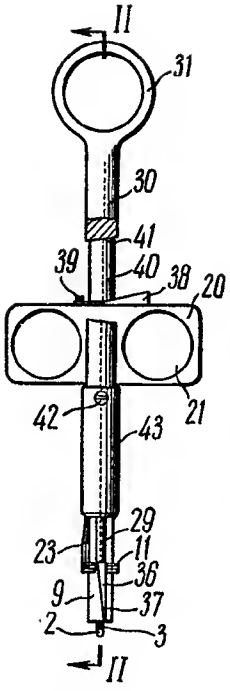

FIG. 1

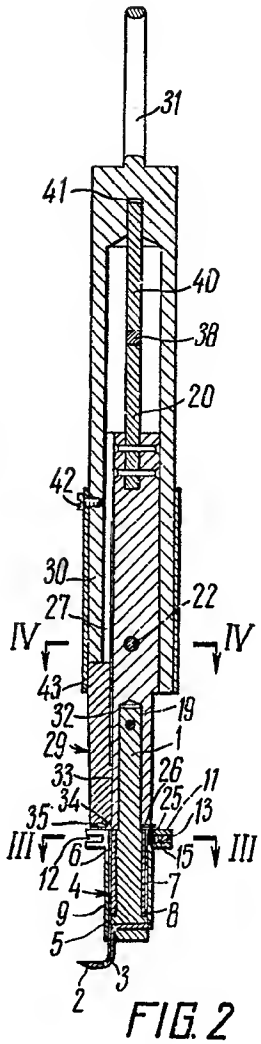

FIG. 2

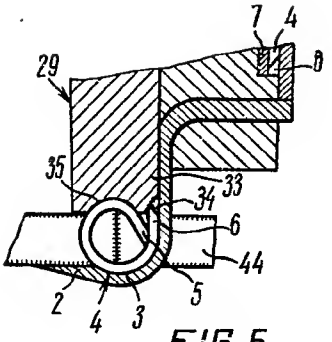

FIG. 5

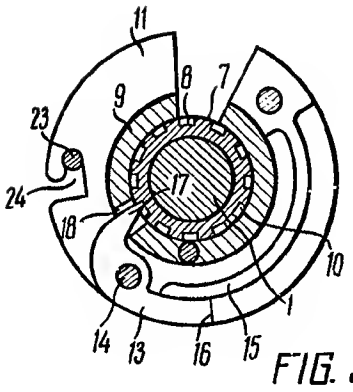

FIG. 3

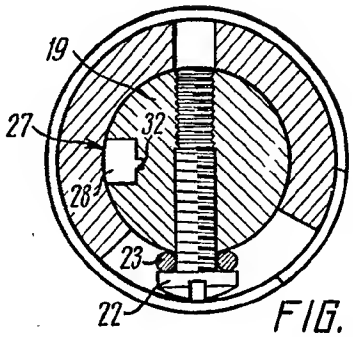

FIG. 4

1358466 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

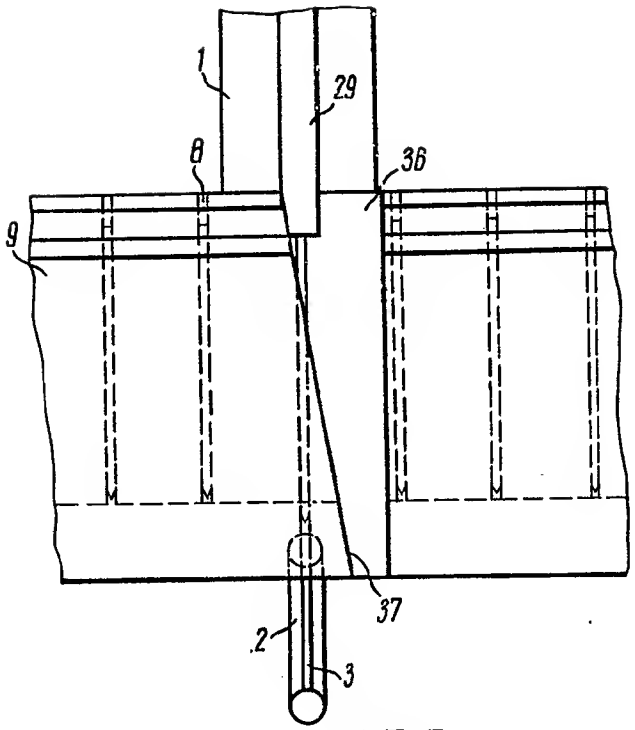

FIG. 6